

IN THE CLAIMS:

Please note that all claims currently pending and under consideration in the referenced application are shown below. This listing of claims will replace all prior versions and listings of claims in the application.

Please amend claims 1 and 8 as set forth below.

Listing of Claims:

1. (Presently Amended) A method of converting one or more reactants to a desired end product, comprising:
introducing a reactant stream ~~into an injection line~~ at one end of an axial reactor;
~~independently introducing a stream of heating gas into the injection line for mixture with the reactant stream heating the reactant stream as the reactant stream flows axially through an injection line;~~
thoroughly mixing the reactant stream with ~~a the~~ heating gas within the injection line ~~to produce a thoroughly mixed reactant stream prior to entry thereof into a reactor chamber;~~
passing the thoroughly mixed reactant stream axially from the injection line to ~~a the~~ reactor chamber;
maintaining a volume defined by the reactor chamber at a substantially uniform temperature as the thoroughly mixed reactant stream passes therethrough; and
producing a desired end product stream at a location adjacent an outlet end of the axial reactor.
2. (original) The method of claim 1, wherein the reactant stream comprises methane and the desired end product comprises acetylene.
3. (original) The method of claim 1, wherein the reactant stream comprises methane or carbon monoxide and the desired end product comprises hydrogen.

4. (original) The method of claim 1, wherein the reactant stream comprises a titanium compound and the desired end product comprises titanium or titanium dioxide.
5. (previously presented) The method of claim 1, wherein maintaining the reactor chamber at a substantially uniform temperature includes forming the chamber to comprise a hot wall surrounding the volume and forming an insulating layer on an interior surface of the hot wall.
6. (previously presented) The method of claim 5, further comprising forming the insulating layer from a material selected from the group consisting of carbon, boron nitride, zirconia, silicon carbide, and combinations thereof.
7. (previously presented) The method of claim 5, wherein the temperature within the reactor chamber is maintained between about 1500°C and about 2500°C.
8. (Presently Amended) A method for thermal conversion of one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles, the method comprising:
introducing a stream of plasma arc gas between electrodes of a plasma torch including at least one pair of electrodes positioned adjacent to an inlet end of an axial reactor chamber, the stream of plasma arc gas being introduced at a selected plasma gas flow rate while the electrodes are subjected to a selected plasma input power level to produce a plasma in a restricted diameter injection line;
forming a gaseous stream by injecting at least one reactant into the injection line and thoroughly mixing the reactant into the plasma within the injection line and prior to entry thereof into a reactor chamber;
introducing the gaseous stream into a reactor chamber;
maintaining a volume defined by the reactor chamber at a substantially uniform temperature as

the thoroughly mixed stream passes therethrough;
bringing the mixed reactant stream to an equilibrium state;
cooling the gaseous stream including passing the gaseous stream through a nozzle at an outlet
end of the reactor chamber; and
separating the desired end product from gases remaining in the cooled gaseous stream.

9. (previously presented) The method of claim 8, wherein the at least one reactant comprises methane and the desired end product comprises acetylene.

10. (previously presented) The method of claim 8, wherein the at least one reactant comprises methane or carbon monoxide and the desired end product comprises hydrogen.

11. (previously presented) The method of claim 8, wherein the at least one reactant comprises a titanium compound and the desired end product comprises titanium or titanium dioxide.

12. (previously presented) The method of claim 8, wherein maintaining the reactor chamber at a substantially uniform temperature includes forming the reactor chamber to comprise a hot wall surrounding the volume and forming an insulating layer on an interior surface of the hot wall.

13. (previously presented) The method of claim 12, further comprising surrounding the hot wall with a cooling layer to prevent degradation of the reaction chamber.

14. (previously presented) The method of claim 12, wherein forming an insulating layer comprises disposing a carbon layer on the interior surface of the hot wall and, wherein surrounding the hot wall with a cooling layer comprises contact a surface of the hot wall with a layer of water.

15. (previously presented) The method of claim 12, wherein the temperature of the volume defined by the reactor chamber is maintained between about 1500°C and about 2500°C.

16. (previously presented) The method of claim 12, wherein the temperature of volume defined by the reactor chamber is maintained between about 1700°C and 2000°C.

17. (previously presented) The method of claim 12, wherein cooling the gaseous stream includes passing the gaseous stream through a coaxial convergent-divergent nozzle positioned in the outlet end of the reactor chamber.

18. (previously presented) The method of claim 12, wherein thoroughly mixing the reactant into the plasma within the injection line includes producing a turbulent flow of the at least one reactant and the plasma within the injection line.

19-32. (cancelled)

33. (previously presented) A method for thermally converting one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles, the method comprising:

introducing a reactant stream into an axial reactor at an upstream end thereof ;

heating the reactant stream as the reactant stream flows axially through an injection line;

passing the reactant stream axially through a volume defined by a reactor chamber of the axial reactor;

maintaining the volume defined by the reactor chamber at a substantially uniform temperature; producing a stream containing the desired product stream at a location adjacent an outlet end of the reactor chamber; and

cooling stream containing the desired end product exiting from the reactor chamber.

34. (previously presented) The method of claim 33, further comprising producing a turbulent flow within the injection line and thoroughly mixing the reactant stream with a heating gas within the turbulent flow.

35. (previously presented) The method of claim 33, wherein introducing a reactant stream includes providing at least one reactant selected from the group consisting of titanium tetrachloride, vanadium tetrachloride, aluminum trichloride and natural gas.

36. (previously presented) The method of claim 33, further comprising separating the desired end product from the stream containing the desired end product.

37. (previously presented) The method of claim 33, further comprising providing a converging-diverging nozzle arranged coaxially with the outlet end of the reactor chamber to rapidly cool the stream containing the desired end product.

38. (cancelled)

39. (previously presented) The method of claim 37, wherein the converging-diverging nozzle has a converging section and a diverging section respectively leading to and from a restrictive open throat, the diverging section of the nozzle exhibiting an included angle of less than about 35°.

40. (previously presented) The method of claim 37, further comprising rapidly accelerating the stream containing the desired end product into the nozzle throat while maintaining laminar flow thereof.

41. (cancelled)

42. (previously presented) The method of claim 37, further comprising controlling the residence time and reaction pressure of the reactant stream within the reactor chamber by configuring the restrictive open throat to exhibit a desired cross-sectional area as taken substantially transverse to any flow therethrough.

43. (previously presented) The method of claim 37, further comprising the step of subjecting the stream containing the desired end product to an ultra fast decrease in pressure by smoothly accelerating and expanding the moving stream containing the desired end product along the diverging section of the nozzle to further decrease its kinetic temperature and prevent undesired side or back reactions.

44. (previously presented) The method of claim 33, wherein maintaining the volume defined by the reactor chamber at a substantially uniform temperature includes disposing a carbon layer on an interior surface of the reactor chamber .

45. (previously presented) The method of claim 44, further comprising surrounding the reactor chamber with a cooling layer.

46. (previously presented) A method of forming a metal, metal oxide or metal alloy from a metal-containing compound, the method comprising:
providing a plasma formed from a gas comprising an inert gas, hydrogen, or a mixture thereof;
providing a reagent or a reagent mixture, the reagent or reagent mixture comprising a gaseous or volatilized compound of a selected metal;
thoroughly mixing the reagent or reagent mixture with the plasma at a location upstream from an axial reactor chamber to produce a reactant stream;
passing the reactant stream axially through the reactor chamber;
maintaining the reactor chamber at a substantially uniform temperature;

producing a product stream at a location adjacent an outlet end of the reactor chamber, the product stream including an equilibrium mixture comprising the selected metal, metal oxide or metal alloy, wherein the selected metal, metal oxide or metal alloy being thermodynamically stable;

cooling the product stream exiting the outlet end of the reactor chamber; and

separating the metal, metal oxide or metal alloy from gases remaining in the cooled product stream.

47. (withdrawn) The method of claim 46, wherein the gaseous or volatilized compound of the selected metal is a gaseous or volatilizable halide.

48. (withdrawn) The method of claim 46, wherein the selected metal is titanium, vanadium, or aluminum.

49. (withdrawn) The method of claim 46, wherein the compound of the selected metal is titanium tetrachloride, vanadium tetrachloride, or aluminum trichloride.

50. (previously presented) The method of claim 46, wherein the reagent or reagent mixture further comprises at least one additional reagent capable of reacting at the substantially uniform temperature such that the equilibrium mixture is formed to comprise the metal oxide or metal alloy .

51. (withdrawn) The method of claim 46, wherein the method forms titanium metal, and the reagent or reagent mixture comprises titanium tetrachloride.

52. (withdrawn) The method of claim 46, wherein the method forms vanadium metal, and the reagent or reagent mixture comprises vanadium tetrachloride.

53. (withdrawn) The method of claim 46, wherein the method forms aluminum metal, and the reagent or reagent mixture comprises aluminum trichloride.

54. (withdrawn) The method of claim 46, wherein the method forms an alloy of titanium and a second metal, and the reagent or reagent mixture comprises titanium chloride and a gaseous or volatilizable compound of the second metal.

55. (withdrawn) The method of claim 54, wherein the second metal is vanadium.

56. (original) The method of claim 46, wherein the method forms a metal oxide of the selected metal, and the reagent or reagent mixture further comprises oxygen.

57. (previously presented) The method of claim 46, wherein the method forms titanium dioxide, and the reagent or reagent mixture comprises titanium tetrachloride and oxygen.

58. (previously presented) A method of forming a desired product from a hydrocarbon, the method comprising:
providing a plasma formed from a gas comprising an inert gas, hydrogen, or a mixture thereof;
providing a reagent or a reagent mixture, the reagent or reagent mixture comprising gaseous or volatilized hydrocarbon;
thoroughly mixing the reagent or reagent mixture with the plasma at a location upstream from a reactor chamber to produce a reactant stream;
passing the reactant stream axially through a volume defined by the reactor chamber;
maintaining the volume defined by the reactor chamber at a substantially uniform temperature;
forming a product stream including an equilibrium mixture comprising the desired product, the desired product being thermodynamically stable;
cooling the product stream as it exits an outlet end of the reactor chamber; and

separating the desired end product from gases remaining in the cooled product stream.

59. (original) The method of claim 58, wherein the reagent or reagent mixture comprises natural gas.

60. (original) The method of claim 58, wherein the reagent or reagent mixture comprises methane.

61. (withdrawn) The method of claim 58, wherein the desired product comprises acetylene.

62-87. (cancelled)